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ABSTRACT

A study was designed to determine if soldiers trained to use chemical agents are more proficient in performing their jobs in an environment where lethal chemical agents are used and more confident of their ability to survive. A treatment group, composed of 150 soldiers, knew that their training would involve lethal agents in the Chemical Decontamination Training Facility at Fort McClellan, Alabama. Two control groups, one of 30 soldiers trained in the facility, but with nonlethal agents, and the other of 158 soldiers whose training took place in a different nonlethal environment, were used. Proficiency was evaluated with existing written examinations. Confidence was evaluated with a 10-item questionnaire, using 7-point Likert scales, developed for the study. Analyses of the data indicated that the treatment had not affected job proficiency as measured by the written examinations. However, soldiers in the treatment group had the perception that they were better able to survive in combat and to perform their mission in the event of a chemical attack. (Eight data tables are included in the paper.) (CML)

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EFFECTS OF TRAINING WITH LETHAL CHEMICALS ON JOB PROFICIENCY AND JOB CONFIDENCE

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The Effects of Training with Lethal Chemicals on Job Proficiency and Job Confidence

Chemical warfare causes great physical and even greater psychological damage on the battlefield. History has shown that panic and psychosomatic reactions are genuine hazards on the chemically contaminated battlefield and on a battlefield soldiers believe to be chemically contaminated. Extensive research and development have provided the soldier of today with protective garments, detection, identification, and decontamination equipment far superior to that used by soldiers in past conflicts. The requirement to train soldiers to survive and to operate on a battlefield which may have a chemical environment is not a new one. However, with the formidable threat presented by chemical warfare today, the training need continues to escalate in importance.

Strengthening the soldiers' confidence in their equipment as well as increasing their proficiency in its use is the primary objective of the chemical agent training conducted at the Chemical Decontamination Training Facility at Fort McClellan, Alabama. While wearing full chemical protective gear, soldiers learn to detect, to identify, and to decontaminate chemical agents. Soldiers trained in this facility earn the Military Occupational

Specialty (54B) as a Chemical Operations Specialist and, upon graduation, become the trainers within their assigned commands.

The Chemical Decontamination Training Facility is the first facility of its kind in the Free World, and it is believed to be the only one of its kind in the world. The facility is designed so that training is conducted in large bays, maintained at a negative pressure, to ensure environmental protection. While training in this facility, students go through three training exercises. The first consists of a mock contamination exercise using simulants on the facility's outdoor training pads. The second exercise, held in one of the small training bays in the decontamination facility, affords soldiers the opportunity to detect, to identify, and to decontaminate chemical agents on small weapons. In the third exercise, soldiers go through a more thorough exercise in which they detect and identify an agent on an armored reconnaissance vehicle. Once the agent has been identified, soldiers use equipment to decontaminate the vehicle.

Until the development of the Chemical Decontamination Training Facility, soldiers trained in open air in an agent- free environment. Under certain conditions simulants were used to activate detection and identification equipment. Training in the Chemical Decontamination Training Facility enables soldiers to

work in an environment which contains lethal chemical agents. These agents are GB, a hazardous nerve agent vapor, and VX, a thickened liquid nerve agent hazardous to touch. U.S. Army trainers believe that the more realistic training provided by the Chemical Decontamination Training Facility at Fort McClellan provides the Army with chemical specialists who are more proficient in the use of their equipment and more confident in their own ability to survive and to perform their mission in the event of a chemical attack. This study was designed to determine if soldiers trained using chemical agents are in reality more proficient and confident.

Null hypotheses tested were:

1. There are no significant differences in the levels of job confidence in their ability to survive of soldiers trained in an environment where lethal chemical agents are used and of those not so trained.

2. There are no significant differences in the levels of job proficiency of soldiers trained in an environment where chemical agents are used and of those not so trained.

Methods

Subjects

Group 1, the treatment group, was composed of 150 soldiers. Group 2, the control group for the facility, was made up of 30 soldiers. Group 3, the control group for the training treatment, was composed of 158 soldiers.

While the demographic composition of each class was not exact, it was extremely close. The mean age was 20.72 for the treatment group, 20.40 for the facility control group and 20.53 for the training control group. The mean education level was 12.10 for the treatment group, 12.11 for the facility control group, and 12.01 for the training control group. There were very little differences in the classes with regard to gender, race, or military component. The treatment group contained 132 males and 18 females. The facility control group contained 28 males and 2 females. The training control group contained 150 males and 8 females. The treatment group contained 124 caucasians, 20 blacks, 4 hispanics, 1 mongolian, and 1 American Indian. The facility control group was composed of 24 caucasians, 5 blacks, and 1 hispanic. The training control group was composed of 112 caucasians, 33 blacks, 5 hispanics, 5 mongolians, and 3 American Indians. The treatment

group was made up of 74 active component soldiers, 28 reserve component soldiers, and 48 members of the national guard. The facility control group was made up of 18 active component soldiers, 7 reserve component soldiers, and 5 members of the national guard. The training control group was made up of 109 active component soldiers, 32 reserve component soldiers, and 17 members of the national guard.

Procedure

All soldiers in this study completed basic training and were undergoing the Advanced Individual Training required for the award of the Chemical Operations Specialist, Military Occupational Specialty 54B. This course was 16 weeks and 2 days in length.

The blocks of instruction being evaluated were taught during the fourth to seventh weeks of advanced training. The first block of instruction centered on the detection, identification, and behavior of chemical agents. The second and third blocks of instruction dealt with the operation, maintenance, and procedures involved in deliberate and hasty decontamination of items contaminated with chemical agents. These instructional blocks culminated in a special training exercise.

Group 1, the treatment group, completed the exercise in the Chemical Decontamination Training Facility where a lethal chemical agent was used. The soldiers who made up Group 1 were aware since the beginning of the block of instruction on chemical agents that this exercise would be a culmination of their training and that chemical agents would be used.

Because the Chemical Decontamination Training Facility is an imposing building, Group 2, the control group for the facility, served to determine how much of the additional effect of training in this environment was from the facility and how much was actually from the chemical agent. The culminating exercise for these soldiers took place in the facility but without the presence of a chemical agent. The soldiers knew from the beginning of the block of instruction on chemical agents that they would train in this facility but would not train in a chemical agent environment.

Group 3, the control group for the training, completed the decontamination exercise in full protective gear in an open training area. The decontamination exercise took place in an environment that was free of chemical agents. The soldiers who made up this group knew since the beginning of the block of instruction on chemical agents that this exercise would culminate their training and that the environment would be agent free.

Soldiers in the three groups were not assigned randomly but were studied in the classes to which they were assigned by assignment personnel at the Department of the Army Military Personnel Center. None were preselected. Classes used in this study were identified only by their being ready for the block of training on chemical agent identification and decontamination at the time the facility was ready to use for training. An effort was made to ensure that classes were comparable in their demographic composition and in the capabilities and background of their students.

Soldiers were not specifically selected to participate in the chemical treatment nor were they specifically selected for the other groups. The training control group, Group 3, soldiers were the first classes to be trained in the 54B Military Occupation Specialty during fiscal year 1987. Once the Chemical Decontamination Training Facility construction was completed and the Chemical School was ready to try out the facility, the classes undergoing the decontamination block began training in the facility. These classes made up Group 2. Further tests of the facility were made, and, upon certification of its environmental safety, the chemical environment was added as another treatment in training. Classes were phased in as they came to this block of

training. The first classes of advanced individual training soldiers to go through the facility began their training on 14 April 1987. Classes trained in the Chemical Decontamination Training Facility from 14 April to 30 September 1987 made up Group 1.

Evaluation of the proficiency of the soldiers as a result of these blocks of training was with the administration of existing written end-of-block examinations. No change to the examination or method of administration occurred while evaluating the three groups.

Confidence was evaluated with a questionnaire written by a board of military researchers especially for this study. It consisted of 10 questions, to be answered on a 7-point Likert scale, which addressed the soldiers' confidence in their own ability and in the ability of their classmates to survive a chemical attack, to identify agents, and to decontaminate equipment. This questionnaire was given to the students immediately following the culminating practical exercise at the end of the third block of instruction. It was given to each group in exactly the same manner and at the same point in the training cycle.

Facility

The Chemical Decontamination Training Facility complex consists of an administration building for office space and two classrooms, a small guard house, three outdoor simulant training pads, and a main training building. The main building has nine filtration units. In addition there are also three liquid waste holding tanks, a hazardous waste incinerator, and a solid waste holding building.

The main training building has a medical aid station, a chemical laboratory, male and female locker rooms, a laundry-equipment maintenance area, and a safety control room. A large training bay, capable of holding a large tracked vehicle (tank), and six small bays complete the floor plan.

Equipment

Subjects entering the facility were dressed in chemical protective clothing consisting of a protective overgarment (jacket and trousers), butyl rubber overboots, butyl rubber gloves with cotton lining inserts, and an M17 protective mask with hood.

Equipment used in the detection and identification process included the M8A1 chemical agent alarm and the M256 chemical agent

detector kit. As the nerve agent was poured over the equipment, the vapor set off the M8A1 chemical agent alarm indicating the presence of a chemical agent. Subjects then, with the aid of their M256 chemical agent detector kits, determined which chemical agents were present.

The decontamination of the equipment was accomplished by the application of Decontaminating Solution 2 (DS2) to the contaminated areas of the equipment. The DS2 was applied by using the M11 decontaminating apparatus and the M13 decontaminating apparatus, portable. The actual decontamination consisted of a chemical reaction between the contaminant and the decontaminating solution.

Instruments

The instruments used to evaluate proficiency were the existing end-of-block written tests. These written tests consisted of multiple-choice items dealing with chemical agents, their detection, identification, and the methods used for decontamination. The equipment test consisted of 34 multiple-choice items. The agent detection and identification test consisted of 20 multiple-choice items. The decontamination test consisted of 24 multiple-choice items.

Test items were validated using the normal Army validation procedure as detailed in TRADOC Regulation 351-6. Validation involved try-out of the test items in individual and small groups trials. Participants in these trials were both soldiers who could and could not perform the actual task being tested. Each question was evaluated using a Phi coefficient. After each test item was validated, it was used in the actual class for a minimum of three iterations. After the test had been given three times, an reliability determination was made. Test reliability coefficients as computed using the Kuder-Richardson 20 formula. Reliability coefficients for the equipment test, for the agent detection and identification test, and for the decontamination test were .78, .79,and .81 respectively.

Confidence was evaluated with a questionnaire written especially for this study. It consists of 10 questions to be answered on a 7-point Likert scale. Each question on the questionnaire is valued based on the points selected on the 7-point scale. Scores range from 1 to 7 on each question with a possibility of 10 to 70 points on the entire questionnaire. Higher scores denote greater confidence on the part of the individual completing the questionnaire. Validation of this questionnaire was accomplished in the same manner as proficiency

test validation. The confidence questionnaire had an internal consistency reliability of .8376.

Analyses and Results

An analysis of variance using Scheffe' multiple comparison tests was used to evaluate confidence. The independent variables were the treatment conditions. The treatment conditions were either performance of an exercise in the Chemical Decontamination Training Facility where chemical agents were used (Group 1-treatment), performance of an exercise in simulated contamination in the Chemical Decontamination Training Facility (Group 2-facility control), or performance of an exercise in simulated contamination at an outdoor site (Group 3-training control). The dependent measure was the self rating of job confidence.

As shown in Table 1, a significant difference was discovered between Group 1 and both Groups 2 and 3. The null hypothesis that there are no significant differences in

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Insert Table 1 about here

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the levels of confidence in their ability to survive in soldiers trained in an environment where chemical agents are used and in those not so trained was rejected. Job confidence was significantly higher in soldiers trained in an environment where chemical agents were used. Means and standard deviations are reported in Table 2.

Insert Table 2 about here

An analysis of variance using Scheffe' multiple comparison tests was used to evaluate job proficiency. The independent variables were again the three treatment conditions. The dependent measures were three written tests to determine proficiency.

There were no significant differences in levels of job proficiency of the soldiers in the three conditions as measured by the equipment test. (See Table 3) Means and

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Insert Table 3 about here

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standard deviations for the treatment group, facility control group and the training control group are given in Table 4.

Insert Table 4 about here

There were also no significant differences in levels of job proficiency of the three groups as measured by the agent detection and identification test. (See Table 5.) Means

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Insert Table 5 about here

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and standard deviations for the treatment, facility control and the training control groups respectively are reported in Table 6.

Insert Table 6 about here

There were significant differences in levels of job proficiency of the three groups as measured by the decontamination test. (See Table 7.) Means and standard

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Insert Table 7 about here

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deviations are shown in Table 8. The mean for the facility control group was significantly lower than the means for the

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Insert Table 8 about here

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treatment and training control groups whose means did not differ significantly.

The null hypothesis that there were no significant differences in the levels of job proficiency of soldiers trained in an environment where chemical agents are used and of those not so trained was rejected with the measure being the decontamination test. The null hypothesis could not be rejected when job proficiency was measured by the equipment test and the agent detection and identification test.

Conclusions

As a result of the analyses there is no confidence that the treatment has affected job proficiency as measured either by the equipment test or the agent detection and identification test. The results would initially appear to support the supposition that proficiency as measured by the decontamination test was increased as a result of the treatment. The fact is that the treatment group had a higher mean score than the facility control group while the training control group mean was higher than either the treatment mean or the facility control group mean, although not significantly higher than the treatment group mean. There is no confidence that the treatment has differentially affected proficiency.

If the purpose of the Chemical Decontamination Training Facility is to reassure soldiers that their protective gear does protect them from a chemical agent, that their detection equipment does detect chemical agents, and that items contaminated with a chemical agent can be decontaminated, then training in the Chemical Decontamination Training Facility is a success. Results of this study show that soldiers receiving training in the Chemical Decontamination Training Facility have the perception

that they are better able to survive in combat and to perform their mission in the event of a chemical attack. With this confidence, soldier stress on the battlefield should be lessened in the event of an actual chemically contaminated battlefield.

Table 1

ANOVA Summary for Job Confidence

Source	SS	df	MS	F	Significance
Between subjects	3366.45	2	1683.22	34.30	.000
Within subjects	16438.04	335	49.07	.--	.--

Table 2

Means and Standard Deviations for Job Confidence

Group	M	Standard deviation	n
Treatment	46.00	6.18	150
Facility control	42.90	7.41	30
Control	41.47	7.64	158

Table 3

ANOVA Summary for Equipment Test Proficiency

Source	SS	df	MS	F	Significance
Between subjects	17.71	2	8.86	.15	.86
Within subjects	19704.24	335	58.82	.--	.--

Table 4

Means and Standard Deviations for Equipment Test Proficiency

Group	M	Standard deviation	n
Treatment	91.73	7.75	150
Facility control	92.27	6.66	30
Control	92.18	7.66	158

Table 5

ANOVA Summary for Agent Test Proficiency

Source	SS	df	MS	F	Significance
Between subjects	305.49	2	152.74	1.34	.2621
Within subjects	38064.37	335	113.63	.--	.--

Table 6

Means and Standard Deviations for Agent Test Proficiency

Group	M	Standard deviation	n
Treatment	85.66	8.56	150
Facility control	87.77	5.34	30
Control	87.53	12.95	150

Table 7

ANOVA Summary Table for Decontamination Test Proficiency

Source	SS	df	MS	F	Significance
Between subjects	721.27	2	360.64	15.57	.0000
Within subjects	7761.18	335	23.17	.--	.--

Table 8

Means and Standard Deviations for Decontamination Test Proficiency

Group	M	Standard deviation	n
Treatment	94.92	5.23	150
Facility control	89.83	5.13	30
Control	95.01	4.31	158